

DEHYDRATING CONFLICT

Remember the last time two nations went to war over water? Probably not, since it was 4,500 years ago. But today, as demands for water hit the limits of a finite supply, conflicts are spreading within nations. And more than 50 countries on five continents might soon be spiraling toward water disputes unless they move quickly to strike agreements on how to share the rivers that flow across international boundaries. | **By Sandra L. Postel and Aaron T. Wolf**

Talk of water wars reverberates around the globe these days. United Nations Secretary-General Kofi Annan said last March that “fierce competition for fresh water may well become a source of conflict and wars in the future,” and a recent report of the U.S. National Intelligence Council concludes that the likelihood of interstate conflict will increase during the next 15 years “as countries press against the limits of available water.”

Some dismiss these warnings as alarmist, and history seems to be on their side. The only recorded incident of an outright war over water was 4,500 years ago between two Mesopotamian city-states, Lagash and Umma, in the region we now call southern Iraq. Conversely, between the years 805 and 1984, countries signed more than 3,600 water-related treaties, many showing great creativity in dealing with this critical resource. An analysis of 1,831 international water-related events over the last 50 years reveals that two thirds of these encounters were of a cooperative nature. Nations agreed, for example, to implement joint scientific or technological work and signed 157 water treaties.

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Others argue, however, that when it comes to water the past will not be a reliable guide to the future. A renewable but not infinite resource, fresh water is becoming increasingly scarce: The amount available to the world today is almost the same as it was when the Mesopotamians traded blows, even as global demand has steadily increased. Just since 1950, the renewable supply per person has fallen 58 percent as world population has swelled from 2.5 billion to 6 billion. Moreover, unlike oil and most other strategic resources, fresh water has no substitute in most of its uses. It is essential for growing food, manufacturing goods, and safeguarding human health. And while history suggests that cooperation over water has been the norm, it has not been the rule. One fourth of water-related interactions during the last half-century were hostile. Although the vast majority of these hostilities involved no more than verbal antagonism, rival countries went beyond name-calling on 37 recorded occasions and fired shots, blew up a dam, or undertook some other form of military action.

Lost amidst this perennial debate over whether there will be water wars has been a serious effort to understand precisely how and why tensions develop, beyond the simplistic cause-and-effect equation that water shortages lead to wars. First, whether or not water scarcity causes outright warfare between nations in the years ahead, it already causes enough violence and conflict within nations to threaten social and political stability. And as recent events in the Balkans and sub-Saharan Africa demonstrated, today's civil conflicts

have a nasty habit of spilling over borders and becoming tomorrow's international wars. Second, water disputes between countries, though typically not leading to war directly, have fueled decades of regional tensions, thwarted economic development, and risked provoking larger conflicts before eventually giving way to cooperation. The obsession with water wars begs more important questions: What are the early signs and likely locations of water-related disputes, and what can governments and international agents do to prevent the eruption of violence and political instability?

dwindles. And there is intensifying friction in the lower portions of the Indus River, where Pakistan's Punjab and Sind provinces have been feuding over water for several years. This past April, protests in Karachi turned violent as demonstrators shouting “Give us water” clashed with police.

These incidents should not be dismissed as isolated and unrelated. Water stress is spreading as populations increase [see map on page TK]. By 2015, nearly 3 billion people—40 percent of the projected world population—are expected to live in



Waters of discontent? The Tigris and Euphrates rivers.

INTERNAL STRESS

On July 6, 2000, thousands of farmers in the Yellow River basin of eastern China clashed with police over a government plan to recapture runoff from a local reservoir for cities, industries, and other users. The farmers had long relied on that runoff to irrigate their crops, and a bad drought had made the supply more critical than ever. The incident took place in Shandong, the last province through which the Yellow River runs before reaching the sea. The location is noteworthy because the geography of water-related tensions is beginning to show a pattern: Disputes are erupting within countries in the downstream regions of overtapped river basins. China's Yellow River has been running dry in its lower reaches on and off since 1972, and the dry spells have lengthened markedly in recent years, including a record 226 days in 1997. Likewise, water disputes seem to be brewing between Thailand's northern and southern regions as Bangkok's main river supply, the Chao Phraya,

countries that find it difficult or impossible to mobilize enough water to satisfy the food, industrial, and domestic needs of their citizens. This scarcity will translate into heightened competition for water between cities and farms, between neighboring states and provinces, and at times between nations.

The largest and most combustible imbalance between population and available water supplies will be in Asia, where crop production depends heavily on irrigation. Asia today has roughly 60 percent of the world's people but only 36 percent of the world's renewable fresh water. China, India, Iran, and Pakistan are among the countries where a significant share of the irrigated land is now jeopardized by groundwater depletion, scarce river water, a fertility-sapping buildup of salts in the soil, or some combination of these factors. Groundwater depletion alone places 10 to 20 percent of grain production in both China and India at risk. Water tables are falling steadily in the North China Plain,

Background: Getty Images

View of Tigris and Euphrates Deltas from orbit courtesy of NASA

which yields more than half of China's wheat and one third of its corn, as well as in northwest India's Punjab, another major breadbasket.

As farmers lose access to irrigation water and see their livelihoods deteriorate, they may not only resort to violent protest but migrate across borders and to restive and already overcrowded cities. Such has been the case in Pakistan, where falling agricultural output has prompted a massive rural migration to large urban centers, leading to renewed outbreaks of ethnic violence.

Internal water stresses will also shift international political alliances and add to the burden of humanitarian crises. Countries commonly adapt to water stress by importing more of their food, provided they have the foreign exchange to do so. It takes about 1,000 cubic meters of water to grow one ton of grain. By importing wheat and other staples, water-stressed countries can allocate more of their scarce fresh water to cities and industries, which generate far more economic value per liter than agriculture does. Israel, for example, has done very nicely with this approach. Currently water-stressed countries in Asia, Africa, and the Middle East account for 26 percent of global grain imports. As an additional billion people are added to water-stressed countries over the next 15 years and as more countries join the ranks of food importers, demand for international grain will

increase. A good portion of that increase may come from China, India, and Pakistan—all currently grain self-sufficient, but unlikely to remain so for reasons of water and land scarcity. Their governments will inevitably form stronger alliances with the nations from which they choose to import food. For those nations without sufficient foreign exchange to turn to imports, notably those in sub-Saharan Africa, higher world grain prices will likely mean greater hunger and more calls for humanitarian aid.

Finally, a new cause of water-related tensions has surfaced in just the last few years—the transfer of water system ownership and/or management from public authorities to private multinational corporations. Driving privatization is a confluence of forces: the mounting costs and political liabilities of providing urban water services, increased pressure on governments from the International Monetary Fund (imf) and the World Bank to reduce water subsidies and public-sector debt, and the growing power of private corporations seeking to profit from the sale of water and related services. Especially where privatization takes place in the presence of poverty and inequality, which is to say in most of the developing world, it can lead to civil protest and violence.

Recent events in Cochabamba, Bolivia's third largest city, underscore these risks. Following the privatization of Cochabamba's water system, which had

been plagued by corruption and mismanagement, water rates skyrocketed—resulting in water bills for some residents equal to a quarter or more of their income. Months of civil unrest culminated in April 2000, when the La Paz government sent soldiers into Cochabamba, where some 30,000 protesters had amassed in the central plaza. Several days of violence ensued, leaving one person dead and more than a hundred injured. The conflict abated only when the water system returned to public control.

Cochabamba is an extreme but not isolated case. Activists in Colombia and South Africa likewise have opposed the privatization of water and other municipal services. Meanwhile, imf loan agreements with at least half a dozen countries last year called for some degree of water system privatization. The number of urban dwellers worldwide is projected to nearly double—to 5 billion—by 2025. Unless governments and lenders strengthen municipal water agencies and steer private-sector involvement toward equity as well as efficiency and toward social justice as well as shareholder profit, more violence like that in Cochabamba may be forthcoming.

DAM UNILATERALISTS

Some 261 of the world's rivers are shared by two or more countries. These international watersheds account for about 60 percent of the world's freshwater supply and are home to approximately 40 percent of the world's people. Despite the absence to date of full-scale water wars, unresolved tensions over water have persistently irritated relations, fueled other hostilities, and occasionally led to military action that risked provoking a larger conflict.

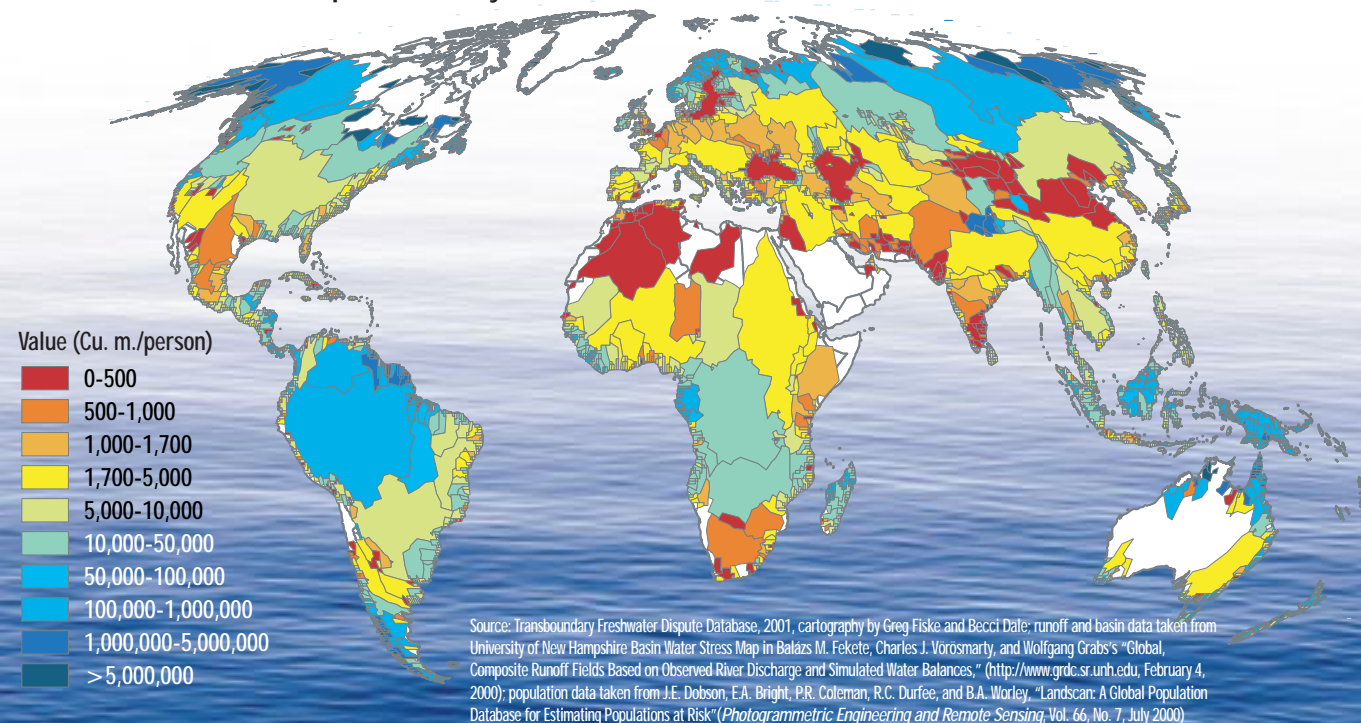
Yet, the overarching lesson to draw from the basins of the Jordan, the Nile, and the Tigris and

Euphrates rivers and other regions of water dispute is not that worsening scarcity will lead inevitably to water wars. It is rather that *unilateral actions* to construct a dam or river diversion in the absence of a treaty or institutional mechanism that safeguards the interests of other countries in the basin is highly destabilizing to a region, often spurring decades of hostility before cooperation is pursued. In other words, the red flag for water-related tension *between* countries is not water stress per se (as is the case *within* countries), but rather a unilateral attempt to develop an international river, usually by a regional power. In the Jordan River basin, for example, violence broke out in the mid-1960s over an "all-Arab" plan to divert the river's headwaters (itself a preemptive move to thwart Israel's intention to siphon water from the Sea of Galilee). Israel and Syria sporadically exchanged fire between March 1965 and July 1966. Water-related tensions in the basin persisted for decades and only recently have begun to dissipate.

A similar sequence of events transpired in the Nile basin, which is shared by 10 countries—of which Egypt is last in line. In the late 1950s, hostilities broke out between Egypt and Sudan over Egypt's planned construction of the Aswan High Dam. The signing of a treaty between the two countries in 1959 defused tensions before the dam was built. But no water-sharing agreement exists between Egypt and Ethiopia, where some 85 percent of the Nile's flow originates, and a war of words has raged between these two nations for decades. Along with civil war and poverty, such verbal threats have likely

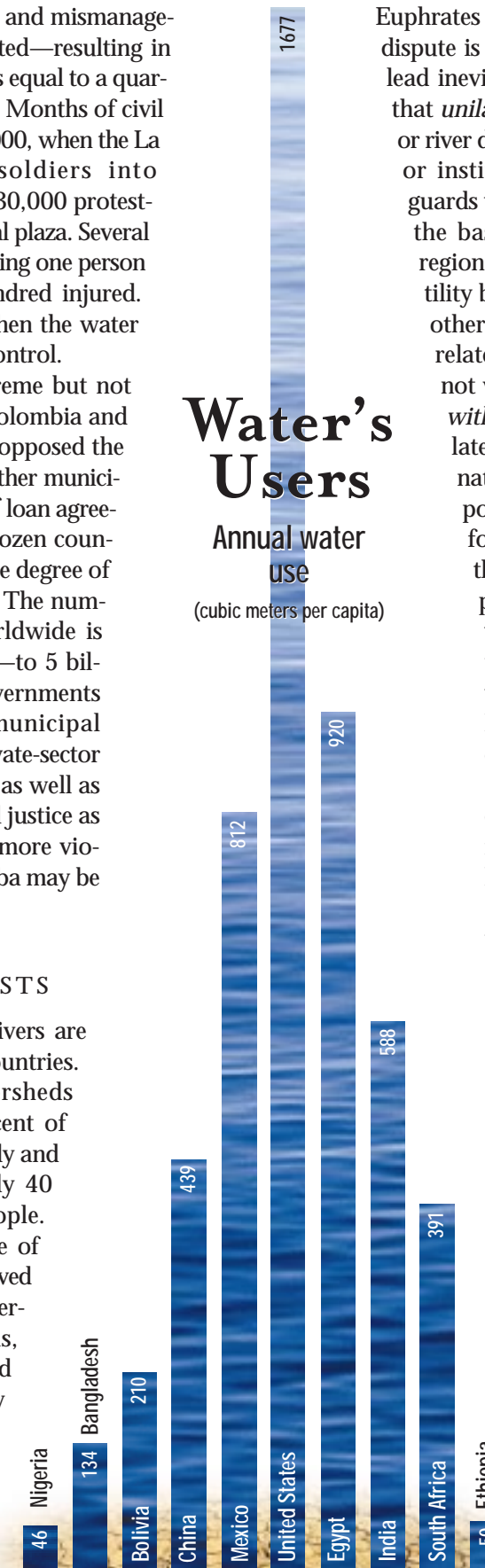
A Parched Planet

Cubic Meters of Water per Person by Basin



Water's Users

Annual water use
(cubic meters per capita)



Note: Methods and years of estimates vary so figures provide only an approximate comparison between countries. Source: *World Resources 2000-2001* (Washington: World Resources Institute, 2000)

inhibited Ethiopia's water development, leaving the Horn of Africa more vulnerable to drought and famine. Meanwhile Egypt, the regional power, has continued to pursue large-scale river basin schemes unilaterally. As in the case of the Jordan, only in recent years have the Nile nations begun to work cooperatively toward a solution.

Similar scenarios have unfolded in a number of other river basins. India unilaterally constructed a barrage during the 1960s and early 1970s on the Ganges River at Farakka, near the border with

The unprecedented degree of current water stress is creating more zero-sum situations both within and between countries.

Bangladesh, in order to channel more river water to the port of Calcutta. This diversion left Bangladesh with significantly less water for irrigation during the dry season. A 20-year period of intermittent hostility and instability ensued, including increased migration of desperate Bangladeshis across the border to India.

These conflicts share a common trajectory: unilateral construction of a big dam or other development project, leading to a protracted period of regional insecurity and hostility, typically followed by a long and arduous process of dispute resolution. A two-year study of conflict and cooperation within international river basins by researchers at Oregon State University found that the likelihood of conflict increases significantly whenever two factors come into play. The first is that some large or rapid change occurs in the basin's physical setting (typically the construction of a dam, river diversion, or irrigation scheme) or in its political setting, especially the breakup of a nation that results in new international rivers. Secondly, existing institutions are unable to absorb and effectively manage that change—i.e., when there is no treaty spelling out each nation's rights and responsibilities with regard to the shared river nor any implicit agreements or cooperative arrangements. Even the existence of technical working groups can provide some capability to manage contentious issues, as they have in the Middle East.

Looking ahead, then, which river basins are ripe for the onset of tensions or conflict over the next 10 years? Where are dams or diversions

planned or under construction that may hurt other countries and where there is no mechanism for resolving resulting disputes? The accompanying map [see page TK] shows the location of 17 such basins, along with the four in which serious unresolved water disputes already exist or are being negotiated. These basins at risk encompass 51 nations on five continents in just about every climatic zone. Eight of the basins are in Africa, primarily in the south, while six are in Asia, mostly in the southeast. Few are on the radar screens of water-and-security analysts.

Consider, for example, the Salween River, which rises in southern China, then flows into Myanmar (Burma) and Thailand. Each of these nations plans to construct dams and development projects along the Salween, and no two sets of plans are compatible. China, moreover, has not lately been warm

to notions of water sharing. It was one of just three countries that voted against a 1997 U.N. convention that established basic guidelines and principles for the use of international rivers. Add in other destabilizing factors in the Salween basin—including the status of Tibet, indigenous resistance movements, opium production, and a burgeoning urban population in Bangkok—and the familiar conflict trajectory emerges. Without a treaty in place, or even regular dialogue between the nations about their respective plans, there is little institutional capacity to buffer the inevitable shock as construction begins.

Consider, too, the Okavango, the fourth largest river in southern Africa. Its watershed spans portions of Angola, Botswana, Namibia, and Zimbabwe, and its vast delta in northern Botswana offers world-renowned wildlife habitat—the “jewel of the Kalahari.” In 1996, drought-prone Namibia revived colonial plans to divert Okavango water to its capital city of Windhoek. Angola and especially Botswana object to the scheme because of its potential harm to the people and ecosystems that depend on the Okavango's flow for their existence. The main institution that can help manage the dispute is the fledgling Okavango Commission, formed in 1994 to coordinate plans in the basin. The commission has recently received renewed support from the Southern Africa Development Community, the U.S. Bureau of Reclamation, and other agencies, but the water dispute continues to simmer.

Several river basins are at risk of future dis-

putes more because of rapid changes in their political settings than any specific dam or development scheme. The breakup of the Soviet Union resulted in several new international river basins almost overnight, and, not surprisingly, institutional capacity for managing water disputes in them is weak. The watershed of Central Asia's Aral Sea, for instance, spanned five Soviet republics that are now independent countries. Tensions among the young nations quickly arose both over how to share the Amu Darya and Syr Darya, the two rivers that feed the Aral Sea, as well as how to ameliorate the human and environmental tragedy caused by the sea's dramatic shrinking—a result of 40 years of river diversions masterminded by Moscow to grow cotton in the Central Asian deserts. With assistance from international agencies, these young governments have taken tentative steps toward trying to resolve their water dilemmas.

Other recently internationalized basins are only beginning to establish channels of cooperation. The Kura-Araks river system, for example, runs through the politically volatile Caucasus, including the newly independent countries of Armenia, Georgia, and Azerbaijan. The river system is the source of drinking water for large portions of these nations, but millions of tons of untreated sewage and industri-

al waste regularly push the level of water pollution to 10 to 100 times international standards. On top of the pollution problems, some forecasts project severe water shortages within 10 years. These water strains exacerbate, and are exacerbated by, relations over other contentious issues in the region, notably those of Nagorno-Karabakh and the proposed pipeline to transport Caspian crude oil across the region to Turkey.

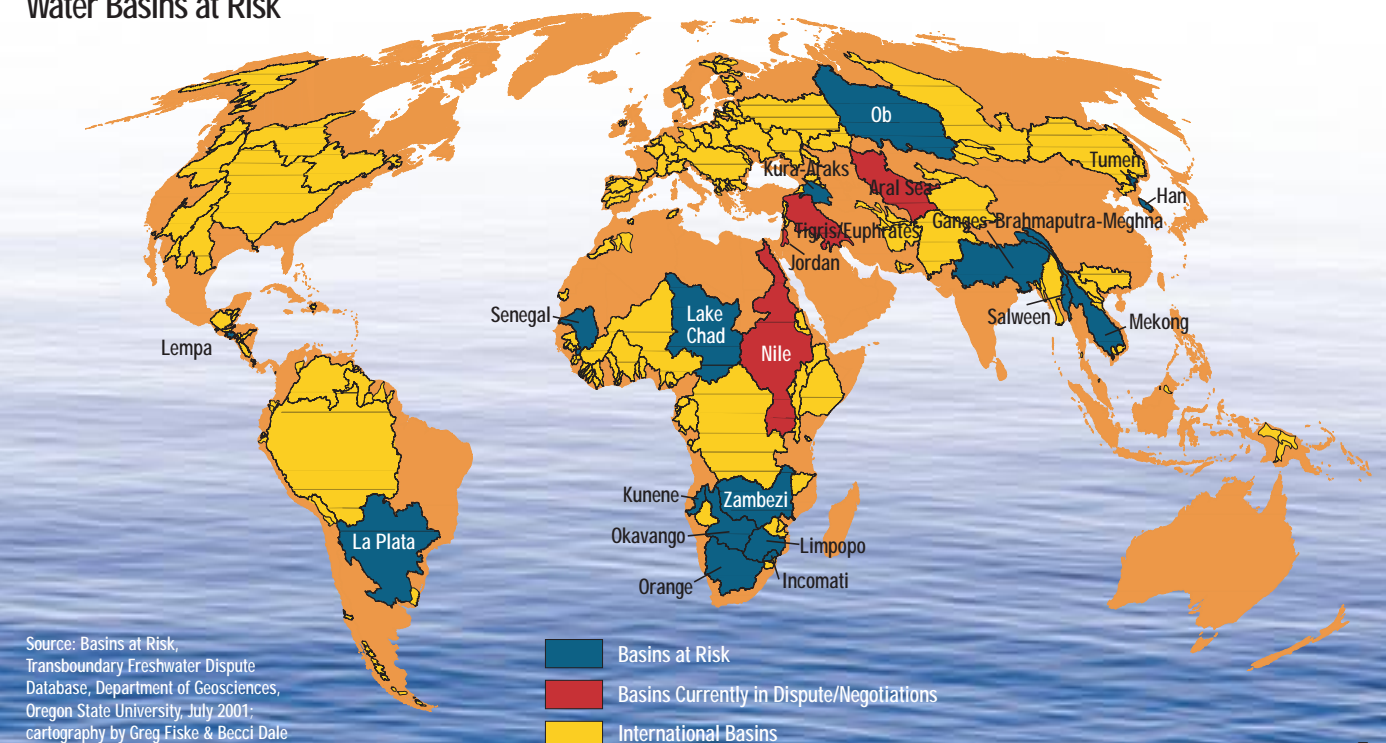
REDUCING WATER PRESSURE

History supports the hopeful notion that fresh water may foster cooperation more often than conflict in the years ahead. Water sharing has regularly brought even hostile neighboring states together. But the unprecedented degree of current water stress is creating more zero-sum situations—in which one party's gain is perceived as another's loss—both within and between countries. The challenge to governments and international bodies is to recognize the new geography and causes of water-related conflict and to embrace three guiding principles as they act to promote water security.

First, efforts to increase the productivity of water use—output per unit of water—are key to defusing tensions as water stress worsens. Measures such as

Up for Grabs

Water Basins at Risk



drip irrigation (a highly efficient technique that delivers water directly to the roots of crops), shifts in cropping patterns, recycling and reusing wastewater, and water-thrifty household appliances enable cities and farming regions to do more with less water. Since agriculture accounts for two thirds of water use worldwide, and 80 to 90 percent in many developing countries, increasing the productivity of irrigation water is particularly critical. Several water-short urban areas, including greater Los Angeles and Beijing, are investing in conservation improvements on nearby farms in exchange for the water those investments save. The farmers stay in production, the city obtains additional water supplies at a reasonable cost, and cooperation replaces competition. Moreover, where water conservation and productivity improvements eliminate the need for a new dam or river diversion, or allow a big project to be scaled down in size, they also address a major source of tension and conflict. As the costs of desalination decrease, the desalting of contaminated aquifers and of seawater may generate new drinking water supplies and thereby ease tensions in water-scarce regions as well.

Second, stronger policies are needed in most countries to regulate groundwater use, to price irrigation and urban water in ways that encourage thriftiness instead of waste, and to protect rivers and lakes from degradation. Greater assistance to governments from international agencies in carrying out these policy and management reforms could help lessen the likelihood of future water conflicts. Letting globalization loose in the form of poorly regulated privatization of water services or unconstrained private funding of dam construction will likely cause more problems than it solves. In this regard, the 2000 report of the independent World Commission on Dams, which establishes recommendations for more socially responsible planning and assessment of dams, is an important step forward. Among other things, the report calls for an open decision-making process that includes all those affected by a proposed dam; a thorough examination of the full range of alternatives to determine if a dam is really the best choice; negotiations with and adequate compensation for those adversely affected by dam construction; and, where international rivers are concerned, regional cooperation and col-

laboration. While some governments have publicly endorsed the commission's recommendations, others—India for instance—have disavowed them.

Third, governments and international organizations must act early and constructively. Some of the most tense water disputes of the 20th century simmered for decades before the rival parties resolved their differences. After three decades of tension in the Jordan basin, Israel and Jordan included a water-sharing provision in the peace treaty they signed in 1994. Tensions among the Nile basin countries are finally easing, thanks in part to unofficial dialogues among scientists and technical specialists that have been held since the early 1990s and more recently to a ministerial-level "Nile Basin Initiative" facilitated by the United Nations and the World Bank. India and Bangladesh ended a 20-year dispute in 1996 with the signing of a treaty that sets out specific terms for sharing the dry-season flow of the Ganges.

The prevailing ad hoc pattern—implementing agreements, sometimes decades after a crisis emerges—is not only risky and inefficient, but in many cases preventable. The key is establishing a process of cooperation early in the trajectory before serious hostilities erupt that make it difficult for nations to sit around a negotiating table together. The Indus basin offers a good example. After their independence in 1947, India and Pakistan nearly

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went to war over the waters of the Indus, which were awkwardly divided by the new political borders. World Bank President Eugene Black used his good offices to mediate the dispute, a long but ultimately successful effort that culminated in the 1960 Indus Waters Treaty.

Strong institutions make a difference. Treaties that provide for effective monitoring and enforcement are often remarkably resilient, holding even when the signatories are engaged in hostilities over non-water issues. The Indus Waters Treaty survived two wars between the signatories and allowed each

to pursue its agricultural and economic plans without risking the ire of the other. Long-term programs of joint fact-finding, technical cooperation, and other initiatives that establish a climate of cooperation among countries can pave the way for resolving disputes when they do arise. The U.S. State Department, other donor countries, and a number of U.N. agencies have established a Global Alliance for Water Security aimed at coordinating assistance in priority regions, which may help countries get ahead of the crisis curve.

Most of humanity's long history with water management has focused on developing ways to capture

and deliver water in ever greater quantities to people, industries, and farms. We have more or less mastered the technologies that enable us to bend nature to our will. This success, however, has not created a water-secure world. Together, more effective technologies, policies, and international institutions can help prevent and resolve water disputes. But the stresses on rivers and water supplies are now so great and so widespread that we cannot wait for these measures to gradually evolve. We must implement them before long periods of verbal threats, hostilities, environmental degradation, and human suffering engulf more regions of the globe. **FP**

[[Want to Know More?](#)]

For an overview of global water stress and the sustainability of irrigated agriculture, see Sandra Postel's *Pillar of Sand: Can the Irrigation Miracle Last?* (New York: W.W. Norton, 1999) as well as many publications of the International Water Management Institute. Also see Postel's "Growing More Food with Less Water" (*Scientific American*, February 2001). For coverage of a wide range of water topics and data, see Peter Gleick's *The World's Water: The Biennial Report on Freshwater Resources* (Washington: Island Press, 1998 and 2000) and the Web sites of the Pacific Institute for Studies in Development, Environment, and Security and the World Resources Institute's environmental information portal. An excellent new source on technologies and measures to conserve water is Amy Vickers's *Handbook of Water Use and Conservation* (Amherst: WaterFlow Press, 2001).

There is good recent literature on both the dangers and promises of shared river systems. Arun Elhance focuses on developing countries in *Hydropolitics in the Third World: Conflict and Cooperation in International River Basins* (Washington: U.S. Institute of Peace Press, 1999). The Middle East is covered extensively in Asit Biswas's, ed., *International Waters of the Middle East: From Euphrates-Tigris to Nile* (Oxford: Oxford University Press, 1994) and Hussein Amery and Aaron Wolf's, eds., *Water in the Middle East: A Geography of Peace* (Austin: University of Texas Press, 2000). For a diplomat's perspective of the process from armed conflict to unofficial dialogue to peace negotiations, see Munther Haddadin's *Diplomacy on the Jordan* (Dordrecht: Kluwer Academic Publishers, forthcoming). An edited volume of classic papers on water disputes at various scales is Wolf's, ed., *Conflict Prevention and Resolution in Water Systems* (Cheltenham: Edward Elgar, 2001).

Wolf, Shira Yoffe, and Mark Giordano's "International Waters: Identifying Basins at Risk" (Water Policy, forthcoming) gives details on the Oregon State University (OSU) study on indicators of water conflict and basins at risk. Related articles and primary information related to conflict and cooperation over international waters can be found at OSU's Transboundary Freshwater Dispute Database project Web site.

For more information on dams, see the report of the World Commission on Dams, *Dams and Development: A New Framework for Decision-Making* (London: Earthscan, 2000) and the Web site of the International Rivers Network. An interesting interview with Oscar Olivera, who led the protest over privatization of Cochabamba's water system, appeared in *Multinational Monitor* (June 2000).

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